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(54) **Electrical contact bump and a package provided with the same.**

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Description

The present invention relates to an electrical contact bump for electrically connecting an electronic microcircuit chip, such as a semiconductor IC chip, to terminal electrodes on a chip support frame, a package provided with such electrical contact bumps, and a method of forming such electrical contact bumps.

Soldering has often been used to connect the contacts of an electronic microcircuit chip to conductive terminals on a chip support frame. However, reduction of intervals between the connecting terminals of electronic microcircuit resulting from recent miniaturization and increase in the number of the connecting terminals of electronic microcircuits, such as flat package ICs, has made the use of conventional soldering techniques to such purpose difficult. Furthermore, there is a tendency to attach bare IC chips directly to electrodes formed on a glass substrate for the efficient use of a packaging space in electronic desk calculators, electronic watches or liquid crystal displays, which strongly desires effective, precise electrical connecting techniques for substituting soldering.

U.S. Pat. No. 4,661,192 discloses a process for electrically bonding a bare IC chip to electrodes on a chip support frame, in which contact bumps are formed on the bonding pads of the IC chip, and the contact bumps are bonded to conductive terminals on a chip support frame by a conductive adhesive to mount the IC chip directly on the chip support frame.

A process for forming such contact bumps on the input and output electrode pads of an IC chip employs a known plating technique. Another process for the same purpose disclosed in U.S. Pat. No. 4,661,192 is a ball bonding process, in which a metallic contact ball is fixed to an electrode pad of an IC chip by a wire bonder, and then the metallic wire is cut off at the neck of the contact ball. A further process disclosed in U.S. Pat. No. 4,442,967 is a ball bonding process, in which a metallic contact ball is fixed to an electrode pad by a wire bonder, the capillary is then moved laterally from the center of the metallic contact ball over a distance 1.5 to two times the diameter of the metallic wire, and then the capillary is lowered to cut off the metallic wire by the lower end of the capillary.

These known ball bonding processes for forming contact bumps are unable to form the contact bumps in a height necessary for transferring a conductive adhesive to the IC chip, which is necessary for directly mounting an IC chip on a chip support frame, and in a satisfactorily uniform shape. Furthermore, since the top of the raised contact is flat, the conductive adhesive is spread around the raised contact in mounting the IC chip on the chip support frame to short-circuit the adjacent terminals, and hence these known ball bonding processes are not applicable to forming of contact bumps at very small intervals. On the other hand, the raised contact forming process employing plating techniques is complex and requires many processing steps and advanced etching and plating techniques. Moreover, the height of the raised contact is limited by the plating accuracy and cost.

Accordingly, to the US patent 3,373,481 there is provided a technique for securing pedestals to the terminals of integrated circuit elements or devices, allowing the pedestals to make contact with coated substrate interconnected areas of thin films or printed circuit members, and permitting the pedestals to be dissolved in the coating whereby all the pedestals are secured to their matching interconnect areas to effect electrical interconnections. The technique includes the step of thermocompression bonding gold spheres to the terminal by means of a vacuum holder which must then be removed to leave the deformed sphere as an elongated projection. The act of removing the vacuum holder over the shape of the projection does not allow more complicated shapes of projection to be formed.

Accordingly, it is an object of the present invention to provide package comprising a chip support frame provided with minute conductive terminals, and an electronic microcircuit provided with input and output terminals corresponding respectively to the minute conductive terminals of the chip support frame, in which the chip support frame and the electronic microcircuit are connected electrically at a high reliability.

It is another object of the present invention to provide an optimum electrical contact bump having a sufficient height and a shape suitable for high-density packaging for the foregoing package.

It is a further object of the present invention to provide a method of forming uniform electrical contact bumps through very simple processes.

According to the present invention there is provided an electrical contact bump formed on a surface of an electrode pad formed on a substrate, comprising:

a first raised portion formed on the surface of the electrode pad; and

a second raised portion formed on the first raised portion and having a cross sectional area in a plane parallel to the surface of the electrode pad smaller than that of the first raised portion in a plane parallel to the surface of the electrode pad,

characterized in that said second raised portion has a shape of a loop extending at one end thereof from said first raised portion and fixed at th other end thereof to said first raised portion or to said

electrode pad.

According to another aspect of the present invention there is provided a package comprising:

a first substrate provided with a plurality of conductive terminals;

a second substrate provided with a plurality of electrode pads respectively at positions corresponding to the conductive terminals of the first substrate;

a plurality of electrical contact bumps formed respectively on the plurality of electrode pads, and each consisting of a first raised portion formed on a surface of a corresponding electrode pad, and a second raised portion formed on the first raised portion and having a cross sectional area in a plane parallel to the surface of the corresponding electrode pad smaller than that of the first raised portion in a plane parallel to the surface of the corresponding electrode pad; and

droplets of a conductive adhesive respectively bonding the electrical contact bumps and the corresponding conductive terminals of the first substrate,

characterized in that said second raised portion has a shape of a loop extending at one end thereof from said first raised portion and fixed at the other end thereof to said first raised portion or to said electrode pad, and that each droplet of the conductive adhesive contacts the first raised portion at substantially only a surface of the first raised portion on which the second raised portion is formed.

According to a method of the present invention, there is provided a method of forming, on an electrode pad formed on a substrate, an electrical contact bump comprising a first raised portion formed on the electrode pad and a second raised portion on the first raised portion, said method comprising the steps of:

fixedly attaching a ball formed at a free end of a conductive wire held by a capillary to the electrode pad with the capillary to form the first raised portion; and

forming the second raised portion on the first raised portion by extending the conductive wire from the first raised portion and cutting the extended conductive wire with the capillary,

characterized in that the second raised portion forming step comprises the steps of:

looping the conductive wire above the first raised portion to form a looped portion of the conductive wire with the capillary, the looped portion having a fixed end connected to the first raised portion and a free end connected to a portion of the conductive wire extending from the capillary;

fixedly attaching the free end of the looped portion of th conductiv wire to the first raised portion or to the el ctrode pad with the capillary; and cutting the conductive wire extending from the capillary at the free end of the looped portion whereby the second raised portion is formed by the looped portion such that the looped portion is extended at one end thereof from the first raised portion and fixed at the other end thereof to the first raised portion or to the electrode pad.

According to embodiments of the various aspects of the present invention, the two-stepped electrical contact bumps are formed on the input and output terminal pads of an electronic microcircuit chip, and the two-stepped electrical contact bumps are bonded respectively to conductive terminals on a chip support frame with a conductive adhesive. The conductive adhesive is formed in a film on a top surface of the first raised portion so as to cover the second raised portion; that is, the conductive adhesive is not spread substantially around the side surface of the first raised portion.

The electrical contact bumps thus formed in the two-stepped construction have a sufficiently large height, which facilitates transferring the conductive adhesive to the electronic microcircuit chip. In connecting the electronic microcircuit chip to the chip support frame with the conductive adhesive, the upper ends of the raised electrical contact bumps are brought into contact respectively with the conductive terminals of the chip support frame and the spread of the conductive adhesive is controlled by the stepped construction of the first raised portions and the second raised portions.

Preferably, the ratio in the area of a cross section, taken in a plane parallel to the terminal pad surface, of the first raised portion of the electrical contact bump to that of the second raised portion of the same is in the range of 3 : 2 to 5 : 1, and the ratio in height of the second raised portion to the first raised portion is in the range of 1 : 2 to 2 : 1. Such conditions secure high mechanical strength and stability of the electrical contact bumps and provide a step capable of stably securing the conductive adhesive of an amount necessary for connecting the electronic microcircuit chip to the chip support frame. Advantageously, excellent bonding effect is expected when the width of the electrical contact bump is in the range of 60 to 120 μm and the height of the electrical contact bump, namely, the sum of the height of the first raised portion and that of the second raised portion, is in the range of 30 to 90 μm.

It is more preferable to use a flexible conductive adhesive. The use of a flexible conductive adhesive, in combination with the shape of the electrical contact bump capable of securing a necessary amount of the conductive adhesive, enables the electrical contact bumps to be bonded to the conductive terminals on the chip support frame to b bonded highly s curely against mechanical stress. Thus, the present invention provides a

package of a minute, highly reliable connection construction and a high practical value.

The electrical contact bumps employed in the package in accordance with the present invention can be formed by a ball bonding apparatus. A conductive ball is fixed to a terminal pad on a substrate provided with an electrode pattern with a capillary to form the first raised portion and then the conductive wire extending from the first raised portion is bent in a loop to form the second raised portion having the shape of a loop. Thus, the two-stepped electrical contact bumps meeting the foregoing conditions can easily and stably be formed. Since the second raised portion projects continuously from the first raised portion in the shape of a loop, the second raised portion has a stable strength and is formed in a shape so that the ratio in sectional area of the second raised portion to the first raised portion is appropriate to form a film of the conductive adhesive.

The aforesaid method of forming the electrical contact bumps forms the first raised portion and the second raised portion integrally through the continuous operation of the ball bonding apparatus. Thus, the method is capable of forming electrical contact bumps having a sufficiently large height and uniform shape through a simple process, which, practically, is very advantageous.

Figure 1 is a side elevation of an electrical contact bump in a first embodiment according to the present invention;

Figure 2 is a sectional view of an electrical contact bump in a second embodiment according to the present invention;

Figure 3 is a sectional view of a package in a preferred embodiment according to the present invention;

Figure 4 is a sectional view of assistance in explaining a manner of transferring a conductive adhesive to a substrate of a package in a preferred embodiment according to the present invention;

Figures 5(a), 5(b), 5(c), 5(d), 5(e), 5(f) and 5(g) are sectional views showing different stages of a method of forming an electrical contact bump in a preferred embodiment according to the present invention;

Figures 6, 7(a) and 7(b) are sectional views of electrical contact bumps in preferred embodiments according to the present invention formed by other methods of forming an electrical contact bump embodying the present invention; and

Figure 8 is a perspective view of a plurality of electrical contact bumps formed on the substrate of a s miconductor chip by a method of forming an electrical contact bump in a pref rred embodiment according to the present inv ntion.

An electrical contact bump in a first embodiment according to the present invention will be described with reference to Fig. 1.

Referring to Fig. 1, an electrical contact bump has a first raised portion 7 and a second raised portion 8. The first raised portion 7 is formed, for example, on an electrode pad 2 on a substrate 1 of a semiconductor IC chip. The size of an area of the first raised portion 7 in contact with the electrode pad 2 is the same as or smaller than that of the electrode pad 2. The width W of the first raised portion 7 is in the range of 60 to 120 μm. The first raised portion 7 is substantially a trapezoid or rectangle in its elevation in a plane perpendicular to the electrode pad 2, and may be of any suitable shape, such as a circle or a square, in its top plan view.

The second raised portion 8 of the electrical contact bump is formed on the first raised portion 7. The sectional area a of the second raised portion 8 in a plane parallel to the upper surface of the electrode pad 2 is smaller than the sectional area A of the first raised portion 7 in a plane parallel to the upper surface of the electrode pad 2. The ratio A/a is in the range of 3/2 to 5/1. The shape and position of the second raised portion 8 on the first raised portion 7 are optional provided that the second raised portion 8 is in contact with and projecting upward from the first raised portion 7. The ratio of the height H of the first raised portion 7 to the height h of the second raised portion 8, i.e., H/h, is in the range of 1/2 to 2/1. The first raised portion 7 and the second raised portion 8 may be formed of gold, copper, aluminum, or an alloy containing one of those metals as a main component.

An electrical contact bump in a second embodiment according to the present invention will be described hereinafter with reference to Fig. 2.

Referring to Fig. 2, an electrical contact bump has a first raised portion 7 and a second raised portion 8. The first raised portion 7 is formed, for example, on an electrode pad on the substrate 1 of a semiconductor IC chip. The size of an area of the first raised portion 7 in contact with the electrode pad 2 is the same as or smaller than the size of the electrode pad 2. The width W of the first raised portion 7 is in the range of 60 to 120 μm. The first raised portion 7 is substantially a trapezoid or rectangle in its side elevation in a plane perpendicular to the electrode pad 2, and may be of any shape in its top plan view.

The second raised portion 8 of the electrical contact bump is a loop of a conductive wire projecting from the upper end of th first raised portion 7. The sectional area a of the second raised portion 8 in a plane parallel to the upper surface of the electrode pad 2 is smaller than the sectional area A

of the first raised portion 7 in a plane parallel to the upper surface of the electrode pad 2, and the ratio A/a is in the range of 3/2 to 5/1. The shape and position of the second raised portion 8 on the first raised portion 7 are optional provided that the second raised portion 8 is in contact with and projecting upward from the upper end of the first raised portion 7. The ratio of the height H of the first raised portion 7 and the height h of the second raised portion 8, i.e., H/h, is in the range of 1/2 to 2/1. The first raised portion 7 and the second raised portion 8 may be formed of gold, copper, aluminum, or an alloy containing one of those metals as a main component.

Thus formed by bending a conductive wire in a loop, the second raised portion 8 of the electrical contact bump has a stable mechanical strength.

A package in a preferred embodiment according to the present invention employing the electrical contact bump of Fig. 2 will be described hereinafter with reference to Figs. 3 and 4.

Referring to Fig. 3, a chip support frame 10 having conductive terminals 11, and a substrate 1 forming, for example, a semiconductor IC chip having electrode pads 2 are disposed with the electrode pads 2 opposite to the corresponding conductive terminals 11, respectively.

The second raised portions 8 are enclosed respectively in droplets of a flexible conductive adhesive 12. In forming the droplets of the conductive adhesive 12, the conductive adhesive is applied over the surface of a flat plate 14 in a film having a uniform thickness in the range of 10 to 40 μm as shown in Fig. 4. Then, the semiconductor IC chip is placed on the plate 14 with the surface of the substrate 1 thereof having the electrical contact bumps facing the film of the conductive adhesive 12 so that the second raised portions 8 and the end surfaces of the first raised portions 7 where the second raised portions 7 are joined to the first raised portions 7 are buried in the film of the conductive adhesive 12. Then the substrate 1 of th semiconductor IC chip is raised in a direction perpendicular to the surface of the plate 14 coated with the conductive adhesive 12. Thus, the conductive adhesive 12 can be applied simultaneously only to each of the second raised portions 8 of the electrical contact bumps formed on the substrate 1 of the semiconductor IC chip to coat each of the second raised portions 8 perfectly and individually with the conductive adhesive 12. Since the second raised portions 7 are coated with the conductive adh sive 12 in such manner, the conductive adhesive will not spread below the first raised portions 7 near to the electrode pads 2, and hence there is no possibility that the adjacent electrode pads 2 are short-circuited by the conductive adhesive 12, which enhances the reliability of the connections.

Although it was specified in th foregoing description of the process of coating the second raised portions 8 with the conductive adhesive 12 that the thickness of the film of the conductive adhesive 12 is in the range of 10 to 40 μm, the thickness of the film of the conductive adhesive 12 is dependent on the height of the electrical contact bumps formed on the electrode pads 2 of the substrate 1 of the semiconductor IC chip, and the foregoing specification is only an example and not restrictive.

The substrate 1 is placed on the chip support frame 10 with the droplets of the conductive adhesive 12 in coincidence and in contact respectively with the corresponding conductive terminals 11 on the chip support frame 10.

In the package employing such two-stepped electrical contact bumps, the thickness of the film of the conductive adhesive 12 and the spread of the same are controlled by the electrical contact bumps, and hence the electrical contact bumps can be provided in a high density. The use of the flexible conductive adhesive 12 makes the package highly resistant to stress and enhances the reliability of the package.

A method of forming the electrical contact bumps of Fig. 2 will be described hereinafter with reference to Figs. 5(a) to 5(g), 6, 7(a) and 7(b). This method employs a ball bonding apparatus, which is used generally in this technical field, to form the electrical contact bump.

In this example, the ball bonding apparatus is Model 1419 of Kulicke and Soffa, however, the ball bonding apparatus is not limited thereto; any suitable ball bonding apparatus may be employed. In this example, the electrode pad 2 formed on the surface of the substrate 1 of the semiconductor IC chip is an aluminium pad of 1 μm in thickness and 100 μm in width.The semiconductor IC chip is a standard MOS IC chip, and the dimensions of the substrate 1 is 6mm x 6mm x 0.5mm (236 mills x 236 mils x 20 mils).

Referring first to Fig. 5(a), the substrate 1 is positioned on a heat block 13 heated at 180 °C and is held fixedly in place by vacuum to preheat the substrate 1. In this example, the temperature of the heat block is 180 °C for bonding using heat in combination with ultrasonic wave, however, such temperature is not limitative and any temperature suitable for the bonding process is possible.

Then, as shown in Fig. 5(b), a gold wire 5 of 0.0254mm (1 mil) in diameter is inserted in the bore 4 of a standard capillary 3, which is held right above the electrode pad 2 at a height from the electrode pad 2 so that it will not touch the electrode pad 2. A ball 6 having a diameter approximately two to three times the diameter of the gold wire 5 is formed at the free end of the gold wire 5 by the thermal energy generated by electric dis-

charge. Although the gold wire 5 employed in this example is a standard gold wire of 99.99% in purity for ball bonding, the gold wire 5 is not limited thereto. More preferably, the wire has heat-resistant characteristics that coarse grained crystals are formed by recrystallization in a narrow area of the wire in a portion contiguous with the ball 6 when the wire is melted by thermal energy.

Then, as shown in Fig. 5(c), the capillary 3 is lowered toward the electrode pad 2 so as to bring the ball 6 formed at the free end of the gold wire 5 into fixed contact with the electrode pad 2 to form a first raised portion 7. The first raised portion 7 of an electrical contact bump thus formed was 85 μm diameter and 30 μm height. This bonding process is known as a thermosonic bonding process, which is employed generally in this technical field, in which supersonic vibration and a pressure are applied simultaneously to the wire while the substrate is heated.

Then, as shown in Fig. 5(d), the capillary 3 is raised perpendicularly to the surface of the substrate 1 of the semiconductor IC chip by 0.127mm (5 mils) relative to the gold wire 5 extending from the first portion 7 of the electrical contact bump. Although the height of the tip of the capillary 3 is 0.127mm (5 mils) in this example, the process can be carried out without trouble when the height is not less than 0.076mm (3 mils).

Then, as shown in Fig. 5(e), the capillary 3 is moved continuously from the raised position in parallel to the surface of the substrate 1 over 0.025 to 0.05mm (1 to 2 mils), which is referred to as a reverse motion.

After the reverse motion, the capillary 3 is raised vertically again by 2.5mm (100 mils). The distance of this vertical movement of the capillary 3 is dependent on the shape of a second raised portion 8 and there is no practical problem when the distance is in the range of 0.25 to 5 mm (10 to 200 mils). Then, the capillary 3 is lowered diagonally and oppositely to the direction of the reverse motion within a circular area of 0.1 to 0.15mm (4 to 6 mils) in radius above the first raised portion 7 to press the gold wire 5 with the lower end of the capillary 3 to the first raised portion 7 at a position near the circumference of the same in a step shown in Fig. 5(f). Accordingly, it is desirable that the radius of the circle is slightly smaller than the sum of the radius of the first raised portion of the electrical contact bump and the radius of the extremity of the capillary 3 in order to form the second raised portion 8 securely. There is not any particular restriction on the path and distance of th sliding movement of the capillary 3 relative to the gold wire 5 pass d through the bore 4 thereof, except that th capillary moves so as to form a loop of the gold wire 5 and that the capillary 3 does not move the same path again within a plane perpendicular to the surface of the substrate 1 of the semiconductor IC chip.

Then, as shown in Fig. 5(f), the gold wire 5 is pressed against the periphery of the first raised portion 7 with the lower end of the capillary 3 to bond the gold wire 5 to the first raised portion 7 by the same thermosonic bonding process.

Then, as shown in Fig. 5(g), the gold wire 5 is pulled up together with the capillary 3 to sever the gold wire 5 from the loop at the junction of the loop and the gold wire 5. Consequently, a second raised portion 8 is formed on the first raised portion 7.

Although the free end of the loop of the gold wire 5 is bonded to the periphery of the first raised portion 7 in this example, the free end of the loop of the gold wire 5 may be bonded to the first raised portion 7 at a position other than a position in the periphery of the first raised portion 7. For example, as shown in Fig. 6, the free end of the loop may be bonded to the electrode pad 2 on which the first raised portion 7 is formed by further lowering the capillary 3. It is also possible to form the same electrical contact bumps as those shown in Figs. 5-(g) and 6 through the same ball bonding process on gold bumps 9 formed as base pads by plating as shown in Figs. 7(a) and 7(b).

The two-stepped electrical contact bumps thus formed were 85 μm in diameter and 80 μm in height, namely, the sum H+h of the height H of the first raised portion 7 and the height h of the second raised portion 8. The height varied between the electrical contact bumps in the range of 1 to 5 μm. When necessary, the variation in height can further be reduced and the flatness of a plane including the tops of the electrical contact bumps can further be improved, for example, by pressing a flat and smooth surface of a plate against the electrical contact bumps in parallel to the surface of the substrate 1 of the semiconductor IC chip to reduce the range of variation in height to 0 to 1 μm. Furthermore, the two-stepped electrical contact bumps can be formed in a desired diameter and a desired height by properly regulating the diameter of the ball 6 formed at the free end of the gold wire 5 and using a gold wire having an appropriate diameter according to the shape and purpose of the two-stepped electrical contact bumps. A metallic wire suitable for ball bonding, such as a copper wire or an aluminum wire, may be used instead of the gold wire.

Fig. 8 is a perspective view showing a plurality of electrical contact bumps each consisting of a first raised portion 7 and a second raised portion 8, formed on the substrate 1 of a semiconductor IC chip by an electrical contact bump forming method in a preferred embodiment according to the present invention. A semiconductor circuit pattern

15 and a plurality of electrode pads 2 are formed on the substrate 1 of a semiconductor IC chip, and the plurality of electrical contact bumps are formed respectively on the electrode pads 2.

Claims

1. An electrical contact bump (7,8) formed on a surface of an electrode pad (2) formed on a substrate (1), comprising:

a first raised portion (7) formed on the surface of the electrode pad; and

a second raised portion (8) formed on the first raised portion and having a cross sectional area in a plane parallel to the surface of the electrode pad (2) smaller than that of the first raised portion in a plane parallel to the surface of the electrode pad,

characterized in that said second raised portion (8) has a shape of a loop extending at one end thereof upwards from said first raised portion (7) and fixed at the other end thereof to said first raised portion (7) or to said electrode pad (2).

2. An electrical contact bump according to claim 1, wherein a ratio of the sectional area of the first raised portion (7) to that of the second raised portion (8) is in a range of 3:2 and 5:1 and a ratio of a height of the first raised portion to that of the second raised portion is in a range of 1:2 and 2:1.

3. An electrical contact bump according to claim 1 or 2, wherein the first raised portion (7) has a width in a range of 60 to 120 μm.

4. An electrical contact bump according to any one of claims 1 to 3, wherein a total height of the first and second raised portion is in a range of 30 to 90 μm.

5. An electrical contact bump according to any one of claims 1 to 4, wherein each of the first and second raised portions mainly comprise gold, copper, aluminium or an alloy containing gold, copper or aluminium.

6. A package comprising:

a first substrate (10) provided with a plurality of conductive terminals (11);

a second substrate (1) provided with a plurality of electrode pads (2) respectively at positions corresponding to the conductive terminals (11) of the first substrate (10);

a plurality of lectrical contact bumps formed respectively on the plurality of electrode pads, and each consisting of a first raised portion (7) formed on a surfac of a corresponding electrode pad (2), and a second raised portion (8) formed on the first raised portion (7) and having a cross sectional area in a plane parallel to the surface of the corresponding electrode pad (2) smaller than that of the first raised portion (7) in a plane parallel to the surface of the corresponding electrode pad; and

droplets of a conductive adhesive (12) respectively bonding the electrical contact bumps and the corresponding conductive terminals of the first substrate,

characterized in that said second raised portion (8) has a shape of a loop extending at one end thereof upwards from said first raised portion (7) and fixed at the other end thereof to said first raised portion or to said electrode pad, and that each droplet of the conductive adhesive (12) contacts the first raised portion at substantially only a surface of the first raised portion on which the second raised portion is formed.

7. A package according to claim 6, wherein a ratio of the sectional area of the first raised portion (7) to that of the second raised portion (8) is in a range of 3:2 to 5:1, and a ratio of a height of the first raised portion to that of the second raised portion is in a range of 1:2 to 2:1.

8. A package according to claim 6 or 7, wherein the first raised (7) portion has a width in a range of 60 to 120 μm.

9. A package according to any one of claims 6 to 8, wherein a total height of the first and second raised portion is in a range of 30 to 90 μm.

10. A package according to any one of claims 6 to 9, wherein each of the first and second raised portion mainly comprises gold, copper, aluminium or an alloy containing gold, copper or aluminium.

11. A method of forming, on an electrode pad (2) formed on a substrate (1), an electrical contact bump comprising a first raised portion (7) formed on the electrode pad (2) and a second raised portion (8) on the first raised portion, said method comprising the steps of:

fixedly attaching a ball (6) formed at a free end of a conductive wire (5) held by a capillary (3) to the electrode pad (2) with the capillary to form the first raised portion; and

forming the second raised portion on the first raised portion by extending the conductive

wire from the first raised portion and cutting the extended conductive wire with the capillary,

characterized in that the second raised portion (8) forming step comprises the steps of:

looping the conductive wire (5) above the first raised portion (7) to form a looped portion of the conductive wire with the capillary (3), the looped portion having a fixed end connected to the first raised portion and a free end connected to a portion of the conductive wire extending from the capillary;

fixedly attaching the free end of the looped portion of the conductive wire (5) to the first raised portion (7) or to the electrode pad (2) with the capillary (3); and

cutting the conductive wire (5) extending from the capillary (3) at the free end of the looped portion (8) whereby the second raised portion is formed by the looped portion such that the looped portion is extended at one end thereof from the first raised portion (7) and fixed at the other end thereof to the first raised portion (7) or to the electrode pad (2).

12. A method according to claim 11, wherein the conductive wire mainly comprises gold, copper, aluminium or an alloy containing gold, copper or aluminium.

Patentansprüche

1. Elektrische Kontaktstelle (7, 8), die auf einer Oberfläche einer Elektrodenanschlußfläche (2) vorgesehen ist, die auf einem Substrat (1) ausgebildet ist, mit:
einem ersten angehobenen Abschnitt (7), der auf der Oberfläche der Elektrodenanschlußfläche ausgebildet ist; und
einem zweiten angehobenen Abschnitt (8), der auf dem ersten angehobenen Abschnitt ausgebildet ist, und eine Querschnittsfläche in einer Ebene parallel zur Oberfläche der Elektrodenanschlußfläche (2) aufweist, die kleiner ist als die des ersten angehobenen Abschnitts in einer Ebene parallel zu der Oberfläche der Elektrodenanschlußfläche,
dadurch gekennzeichnet, daß der zweite angehobene Abschnitt (8) die Form einer Schleife aufweist, die sich an ihrem einen Ende von dem ersten angehobenen Abschnitt (7) aus nach oben erstreckt, und an ihrem anderen Ende an dem ersten angehobenen Abschnitt (7) oder an der Elektrodenanschlußfläche (2) befestigt ist.

2. Elektrische Kontaktstelle nach Anspruch 1, bei welcher ein Verhältnis der Schnittfläche des ersten angehobenen Abschnitts (7) und des zweiten angehobenen Abschnitts (8) in einem Bereich von 3 : 2 und 5 : 1 liegt, und ein Verhältnis einer Höhe des ersten angehobenen Abschnitts zu dem des zweiten angehobenen Abschnitts in einem Bereich von 1 : 2 und 2 : 1 liegt.

3. Elektrische Kontaktstelle nach Anspruch 1 oder 2, bei welcher der erste angehobene Abschnitt (7) eine Breite in einem Bereich von 60 bis 120 µm aufweist.

4. Elektrische Kontaktstelle nach einem der Ansprüche 1 bis 3, bei welcher eine Gesamthöhe des ersten und zweiten angehobenen Abschnitts in einem Bereich von 30 bis 90 µm liegt.

5. Elektrische Kontaktstelle nach einem der Ansprüche 1 bis 4, bei welcher sowohl der erste als auch der zweite angehobene Abschnitt hauptsächlich Gold, Kupfer, Aluminium oder eine Legierung enthält, die Gold, Kupfer oder Aluminium enthält.

6. Gehäuse mit:
einem ersten Substrat (10), welches mit mehreren leitfähigen Kontaktstellen (11) versehen ist;
einem zweiten Substrat (1), welches mit mehreren Elektrodenanschlußflächen (2) versehen ist, jeweils an Positionen entsprechend den leitfähigen Anschlußpunkten (11) des ersten Substrats (10);
mehreren elektrischen Kontaktstellen, die jeweils auf den mehreren Elektrodenanschlußflächen vorgesehen sind, und jeweils aus einem ersten angehobenen Abschnitt (7) bestehen, der auf einer Oberfläche einer zugehörigen Elektrodenanschlußfläche (2) ausgebildet ist, und aus einem zweiten angehobenen Abschnitt (8), der auf dem ersten angehobenen Abschnitt (7) ausgebildet ist und eine Querschnittsfläche in einer Ebene parallel zur Oberfläche der zugehörigen Elektrodenanschlußfläche (2) aufweist, die kleiner ist als die des ersten angehobenen Abschnitts (7) in einer Ebene parallel zur Oberfläche der zugehörigen Elektrodenanschlußfläche; und
Tröpfchen aus ein m leitfähigen Kleb r (12), welche jeweils die elektrischen Kontaktstellen und die zugehörigen leitfähigen Anschlußpunkte des ersten Substrats bondieren,
dadurch gekennzeichnet, daß der zweite angehobene Abschnitt (8) die Form einer Schleife

aufweist, die sich an ihrem einen Ende von dem ersten angehobenen Abschnitt (7) nach oben erstreckt, und an ihrem anderen Ende mit dem ersten angehobenen Abschnitt oder mit der Elektrodenanschlußfläche verbunden ist, und daß jedes Tröpfchen des leitfähigen Klebers (12) den ersten angehobenen Abschnitt im wesentlichen nur an einer Oberfläche des ersten angehobenen Abschnitts berührt, auf welchem der zweite angehobene Abschnitt ausgebildet ist.

7. Gehäuse nach Anspruch 6, bei welchem ein Verhältnis der Schnittfläche des ersten angehobenen Abschnitts (7) zu der des zweiten angehobenen Abschnitts (8) in einem Bereich von 3 : 2 bis 5 : 1 liegt, und ein Verhältnis einer Höhe des ersten angehobenen Abschnitts zu der des zweiten angehobenen Abschnitts in einem Bereich von 1 : 2 bis 2 : 1 liegt.

8. Gehäuse nach Anspruch 6 oder 7, bei welchem der erste angehobene Abschnitt (7) eine Breite in einem Bereich von 60 bis 120 µm aufweist.

9. Gehäuse nach einem der Ansprüche 6 bis 8, bei welchem eine Gesamthöhe des ersten und zweiten angehobenen Abschnitts in einem Bereich von 30 bis 90 µm liegt.

10. Gehäuse nach einem der Ansprüche 6 bis 9, bei welchem sowohl der erste als auch der zweite angehobene Abschnitt hauptsächlich Gold, Kupfer, Aluminium oder eine Legierung aufweist, die Gold, Kupfer oder Aluminium enthält.

11. Verfahren zur Herstellung, auf einer auf einem Substrat (1) ausgebildeten Elektrodenanschlußfläche (2), einer elektrischen Kontaktstelle, die einen ersten angehobenen Abschnitt (7) aufweist, der auf der Elektrodenanschlußfläche (2) vorgesehen ist, sowie einen zweiten angehobenen Abschnitt (8) auf dem ersten angehobenen Abschnitt, wobei das Verfahren folgende Schritte umfaßt:
f stes Befestigen einer Kugel (6), die an einem freien Ende eines leitfähigen Drahtes (5) ausgebildet ist, der durch eine Kapillare (3) gehalt n wird, an der Elektrodenanschlußfläche (2) mit der Kapillare, zur Ausbildung des ersten angehobenen Abschnitts; und
Ausbilden des zweiten angehobenen Abschnitts auf dem ersten angehobenen Abschnitt durch Ausbreiten des leitfähigen Drahtes von dem ersten angehobenen Abschnitt und Abschneiden des verlängerten leitfähigen Drahtes durch die Kapillare,
dadurch gekennzeichnet, daß der Schritt zur Ausbildung des zweiten angehobenen Abschnitts (8) folgende Schritte umfaßt:
Bilden einer Schleife des leitfähigen Drahtes (5) oberhalb des ersten angehobenen Abschnitts (7) zur Ausbildung eines Schleifenabschnitts des leitfähigen Drahtes mit der Kapillare (3), wobei der schleifenförmige Abschnitt ein festes Ende aufweist, welches mit dem ersten angehobenen Abschnitt verbunden ist, und ein freies Ende, das mit einem Abschnitt des leitfähigen Drahtes verbunden ist, der sich von der Kapillare aus erstreckt;
festes Befestigen des freien Endes des schleifenförmigen Abschnitts des leitfähigen Drahtes (5) an dem ersten angehobenen Abschnitt (7) oder an der Elektrodenanschlußfläche (2) durch die Kapillare (3); und
Abschneiden des leitfähigen Drahtes (5), der sich von der Kapillare (3) aus erstreckt, an dem freien Ende des schleifenförmigen Abschnitts (8), wodurch der zweite angehobene Abschnitt durch den schleifenförmigen Abschnitt gebildet wird, so daß sich der schleifenförmige Abschnitt an seinem einen Ende von dem ersten angehobenen Abschnitt (7) aus erstreckt, und an seinem anderen Ende an dem ersten angehobenen Abschnitt (7) oder an der Elektrodenanschlußfläche (2) befestigt ist.

12. Verfahren nach Anspruch 11, bei welchem der leitfähige Draht hauptsächlich Gold, Kupfer, Aluminium oder eine Legierung aufweist, die Gold, Kupfer oder Aluminium enthält.

Revendications

1. Bosse de contact électrique (7, 8) formée sur une surface d'une plage de connexion d'électrode (2) formée sur un substrat (1), comprenant :

une première partie surélevée (7) formée sur une surface de la plage de connexion d'électrode ; et,

une seconde partie surélevée (8) formée sur la première partie surélevée et ayant une superficie de section transversale dans un plan parallèle à la surface de la plage de connexion d'électrode (2) plus petite que celle de la première partie surélevée dans un plan parallèle à la surface de la plage de connexion d'électrode ;

caractérisée n ce que ladite seconde partie surélevée (8) a la forme d'une boucl s'étendant à l'une d ses extrémités vers l haut par rapport à ladite première partie suré-

levée (7) et est fixée à son autre extrémité à ladite première partie surélevée (7) ou à ladite plage de connexion d'électrode (2).

2. Bosse de contact électrique selon la revendication 1, dans laquelle le rapport de la superficie de section de la première partie surélevée (7) à celle de la seconde partie surélevée (8) est dans une plage allant de 3/2 à 5/1, et dans laquelle le rapport de la hauteur de la première partie surélevée à celle de la seconde partie surélevée est dans une plage allant de 1/2 à 2/1.

3. Bosse de contact électrique selon la revendication 1 ou 2, dans laquelle la première partie surélevée (7) a une largeur dans une plage de 60 à 120 µm.

4. Bosse de contact électrique selon l'une quelconque des revendications 1 à 3, dans laquelle la hauteur totale de la première et de la seconde parties surélevées est dans une plage de 30 à 90 µm.

5. Bosse de contact électrique selon l'une quelconque des revendications 1 à 4, dans laquelle chacune de la première et de la seconde parties surélevées comprend principalement de l'or, du cuivre, de l'aluminium, ou un alliage contenant de l'or, du cuivre ou de l'aluminium.

6. Boîtier comprenant :

un premier substrat (10) pourvu d'une pluralité de bornes conductrices (11) ;

un second substrat (1) pourvu d'une pluralité de plages de connexion d'électrode (2), respectivement dans des positions correspondant aux bornes conductrices (11) du premier substrat (10) ;

une pluralité de bosses de contact électriques formée, respectivement, sur la pluralité de plages de connexion d'électrode, et chacune constituée d'une première partie surélevée (7) formée sur une surface d'une plage de connexion d'électrode (2) correspondante, et une seconde partie surélevée (8) formée sur la première partie surélevée (7) et ayant une superficie de section transversale dans un plan parallèle à la surface de la plage de connexion d'électrode (2) plus petite que celle de la première partie surélevée (7) dans un plan parallèl à la surface de la plage de connexion d'électrode correspondante ; et,

des goutt l ttes d'une coll conductrice (12) liant respectivement les bosses de contact électrique et les bornes conductrices correspondantes du premier substrat ;

caractérisée en ce que ladite seconde partie surélevée (8) a la forme d'une boucle s'étendant à l'une de ses extrémités vers le haut par rapport à ladite première partie surélevée (7) et est fixée à son autre extrémité à ladite première partie surélevée ou à ladite plage de connexion d'électrode, et en ce que chaque gouttelette de la colle conductrice (12) contacte la première partie surélevée au droit de sensiblement seulement la surface de la première partie surélevée sur laquelle la seconde partie surélevée est formée.

7. Boîtier selon la revendication 6, dans lequel le rapport de la superficie de section de la première partie surélevée (7) à celle de la seconde partie surélevée (8) est dans une plage allant de 3/2 à 5/1, et dans laquelle le rapport de la hauteur de la première partie surélevée à celle de la seconde partie surélevée est dans une plage allant de 1/2 à 2/1.

8. Boîtier selon la revendication 6 ou 7, dans lequel la première partie surélevée (7) a une largeur dans une plage de 60 à 120 µm.

9. Boîtier selon l'une quelconque des revendications 6 à 8, dans lequel la hauteur totale de la première et de la seconde parties surélevées est dans une plage de 30 à 90 µm.

10. Boîtier selon l'une quelconque des revendications 6 à 9, dans lequel chacune de la première et de la seconde parties surélevées comprend principalement de l'or, du cuivre, de l'aluminium, ou un alliage contenant de l'or, du cuivre ou de l'aluminium.

11. Procédé de formation, sur une plage de connexion d'électrode (2) formée sur un substrat (1), d'une bosse de contact électrique comprenant une première partie surélevée (7) formée sur la plage de connexion d'électrode (2) et une seconde partie surélevée (8) sur la première partie surélevée, ledit procédé comprenant les étapes de :

fixation à demeure d'une bille (6), formée à une extrémité libre d'un fil conducteur (5) maintenu par un capillaire (3), à la plage de connexion d'électrode (2), à l'aide du capillaire, pour former la première partie surélevée ; et,

formation d'une seconde partie surélevée sur la première partie surélevée par extension du fil conducteur à partir de la première partie surélevée et coupe, à l'aide du capillaire, du fil conducteur étendu ;

caractérisé en ce que l'étape de formation d la seconde partie surélevée (8) comprend

les étapes de :

formation d'une boucle dans le fil conducteur (5) au-dessus de la première partie surélevée (7) pour former, à l'aide du capillaire (3), une partie en forme de boucle du fil conducteur, la partie en forme de boucle ayant une extrémité fixe connectée à la première partie surélevée et une extrémité libre reliée à une partie du fil conducteur sortant du capillaire ;

fixation à demeure, à l'aide du capillaire (3), de l'extrémité libre de la partie en forme de boucle du fil conducteur (5) à la première partie surélevée (7) ou à la plage de connexion d'électrode (2) ; et,

coupe du fil conducteur (5) sortant du capillaire (3) à l'extrémité libre de la partie en forme de boucle (8), ce par quoi la seconde partie surélevée est formée par la partie en forme de boucle de telle façon que la partie en forme de boucle s'étende à l'une de ses extrémités à partir de la première partie surélevée (7) et soit fixée à son autre extrémité à la première partie surélevée (7) ou à la plage de connexion d'électrode (2).

12. Procédé selon la revendication 11, dans lequel le fil conducteur comprend principalement de l'or, du cuivre, de l'aluminium ou un alliage contenant de l'or, du cuivre ou de l'aluminium.

FIG. 1

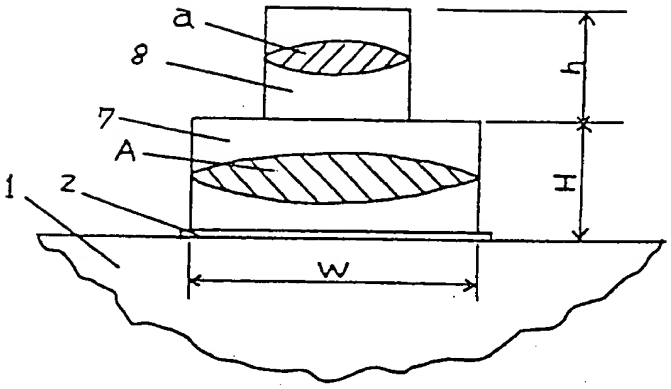


FIG. 2

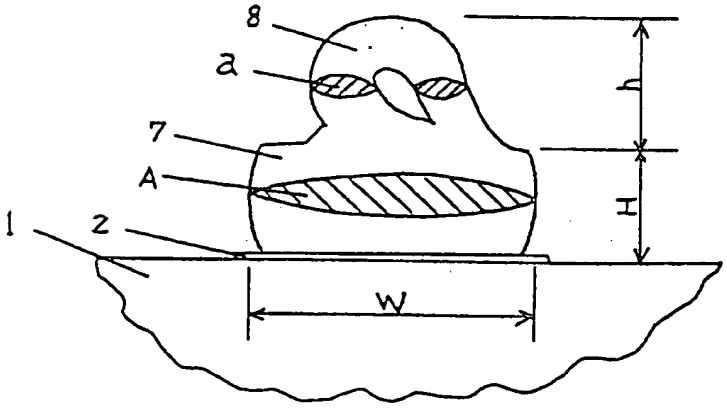


FIG. 3

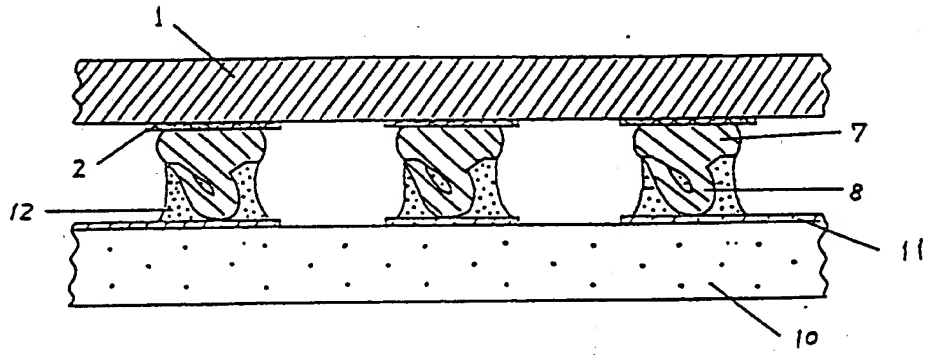


FIG. 4

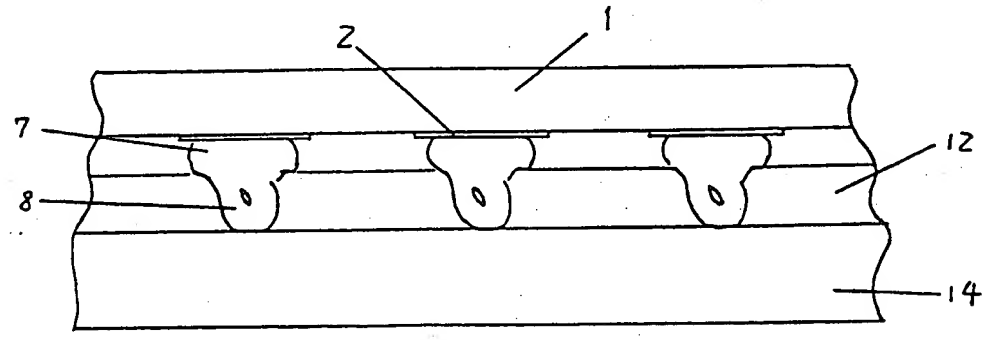


FIG. 5

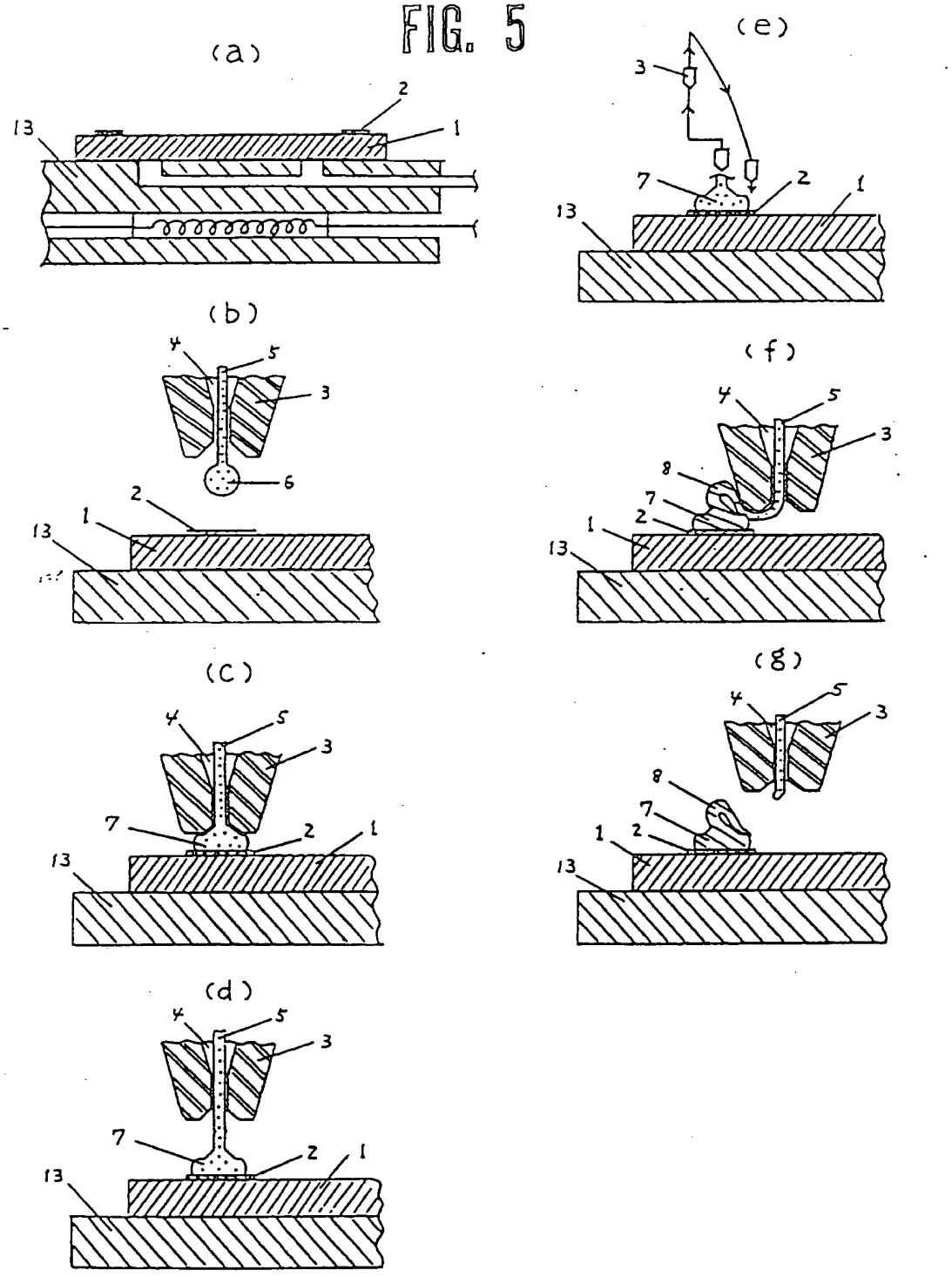


FIG. 6

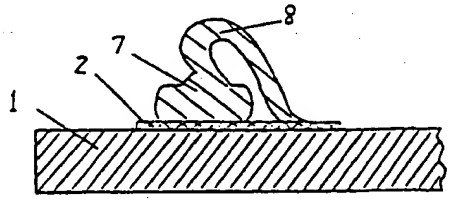
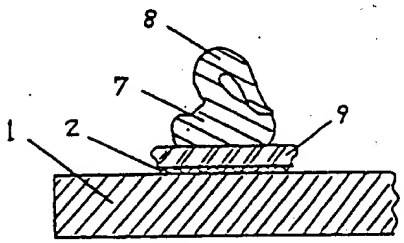


FIG. 7

(a)



(b)

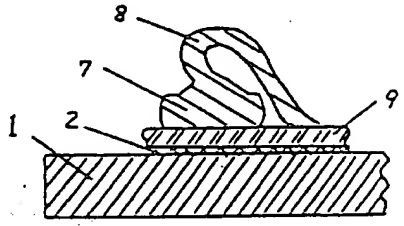


FIG. 8